

SEQUENCE LISTING

<110> Edgar B. Cahoon  
 Rebecca E. Cahoon  
 William D. Hitz  
 Anthony J. Kinney

<120> Membrane-Bound Desaturases

<130> BB1264

<140> US/09/857,524

<141> 2001-06-04

<150> 60/110,784

<151> 1998-12-03

<160> 17

<170> Microsoft Office 97

<210> 1

<211> 1471

<212> DNA

<213> Picramnia pentandra

<220>

<221> unsure

<222> (1402)

<223> n = A, C, G, or T

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 tcaagacacc aggcaaaggg gtctactgct caatcttttt cgtgtctgtg ttggtcgctc 420  
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<211> 448

<212> PRT

<213> Picramnia pentandra

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Ile Ser Lys Trp Thr Lys Glu His Pro Gly Gly Glu Leu Pro Leu Leu  
35 40 45  
Ser Phe Ala Gly Gln Asp Val Thr Asp Ala Phe Ile Ala Tyr His Pro  
50 55 60  
Gly Thr Ala Trp Gln Tyr Leu Asp Arg Phe Phe Thr Gly Tyr Tyr Val  
65 70 75 80  
Gln Asp Tyr Ser Val Ser Glu Met Ser Lys Asp Tyr Arg Arg Leu Val  
85 90 95  
Ser Glu Phe Ser Lys Met Gly Leu Phe Lys Thr Pro Gly Lys Gly Val  
100 105 110  
Tyr Cys Ser Ile Phe Phe Val Ser Val Leu Phe Ala Leu Ser Val Tyr  
115 120 125  
Gly Val Leu Tyr Cys Lys Ser Thr Trp Ala His Leu Cys Ser Gly Leu  
130 135 140  
Leu Met Gly Met Leu Trp Leu Gln Ser Gly Trp Val Gly His Asp Ser  
145 150 155 160  
Cys His Tyr Gln Val Met Pro Asn Arg Lys Leu Asn Arg Leu Phe Gln  
165 170 175  
Ile Ile Ala Gly Asn Val Ile Ala Gly Val Ser Val Ala Trp Trp Lys  
180 185 190  
Leu Asp His Asn Thr His His Phe Ala Cys Asn Ser Ala Asn Leu Asp  
195 200 205  
Pro Asp Ile Gln His Leu Pro Ile Ile Ala Ile Ser Pro Lys Phe Phe  
210 215 220  
Asn Ser Leu Thr Ser Tyr Tyr His Asn Cys Lys Met Thr Tyr Asp Arg  
225 230 235 240  
Ala Ala Arg Phe Phe Val Ser Phe Gln His Trp Thr Phe Tyr Pro Ala  
245 250 255  
Leu Leu Ser Val Arg Leu Tyr Leu Phe Ile Leu Ser Phe Lys Val Val  
260 265 270  
Phe Ser Asn Asn Lys Arg Val Tyr Lys Arg Ser Gln Glu Ile Leu Gly  
275 280 285  
Tyr Ala Ala Phe Leu Thr Trp Tyr Ser Leu Leu Leu Ser Arg Leu Pro  
290 295 300  
Asn Trp Pro Glu Arg Val Met Tyr Phe Thr Ser Cys Leu Ala Val Ala

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305                      310                      315                      320
Gly Phe Gln His Trp Gln Phe Ser Leu Asn His Phe Ala Ser Asn Val
                        325                      330                      335
Tyr Thr Gly Leu Pro Ser Gly Asn Asp Trp Phe His Gln Gln Thr Lys
                        340                      345                      350
Gly Thr Leu Asn Ile Thr Ala Ser Ala Trp Trp Asp Trp Phe His Gly
                        355                      360                      365
Gly Leu His Phe Gln Ile Glu His His Leu Phe Pro Arg Met Pro Lys
                        370                      375                      380
Cys His Phe Arg Lys Ile Ser Pro Ile Val Asn Lys Leu Cys Gln Lys
385                      390                      395                      400
His Asn Leu Ser Tyr Glu Thr Ala Thr Met Trp Glu Ala Asn Lys Met
                        405                      410                      415
Val Tyr Ser Thr Leu Arg Ala Val Ala Met Glu Ala Lys Asp Val Thr
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Lys Pro Val Pro Lys Asn Met Val Trp Glu Ala Met Asn Thr Phe Gly
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<212> DNA
<213> Zea mays

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1764

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<211> 462  
<212> PRT  
<213> Zea mays

<400> 4

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			20					25					30		
Ser	Ala	Asp	Asp	Leu	Trp	Ile	Ser	Ile	Ser	Gly	Asp	Val	Tyr	Asp	Val
		35					40					45			
Thr	Pro	Trp	Leu	Pro	His	His	Pro	Gly	Gly	Asp	Leu	Pro	Leu	Leu	Thr
	50					55					60				
Leu	Ala	Gly	Gln	Asp	Ala	Thr	Asp	Ala	Phe	Ala	Ala	Tyr	His	Pro	Pro
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Ser	Ala	Arg	Pro	Leu	Leu	Arg	Arg	Phe	Phe	Val	Gly	Arg	Leu	Ser	Asp
				85					90					95	
Tyr	Ala	Val	Ser	Pro	Ala	Ser	Ala	Asp	Tyr	Arg	Arg	Leu	Leu	Ala	Gln
			100					105					110		
Leu	Ser	Ser	Ala	Gly	Leu	Phe	Glu	Arg	Val	Gly	Pro	Thr	Pro	Lys	Val
		115					120					125			
Gln	Leu	Val	Leu	Met	Ala	Val	Leu	Phe	Tyr	Ala	Ala	Leu	Tyr	Leu	Val
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Leu	Ala	Cys	Ala	Ser	Ala	Trp	Ala	His	Leu	Leu	Ala	Gly	Gly	Leu	Ile
145					150					155					160
Gly	Phe	Val	Trp	Ile	Gln	Ser	Gly	Trp	Met	Gly	His	Asp	Ser	Gly	His
				165					170					175	
His	Arg	Ile	Thr	Gly	His	Pro	Val	Leu	Asp	Arg	Val	Val	Gln	Val	Leu
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Ser	Gly	Asn	Cys	Leu	Thr	Gly	Leu	Ser	Ile	Ala	Trp	Trp	Lys	Cys	Asn
		195					200					205			
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Leu	Gln	His	Met	Pro	Leu	Phe	Ala	Val	Ser	Pro	Lys	Leu	Phe	Gly	Asn
225					230					235					240
Ile	Trp	Ser	Tyr	Phe	Tyr	Gln	Arg	Thr	Leu	Ala	Phe	Asp	Ala	Ala	Ser
				245					250					255	
Lys	Phe	Phe	Ile	Ser	Tyr	Gln	His	Trp	Thr	Phe	Tyr	Pro	Val	Met	Cys
			260					265					270		
Ile	Ala	Arg	Ile	Asn	Leu	Leu	Ala	Gln	Ser	Ala	Leu	Phe	Val	Leu	Thr
		275					280					285			

Glu Lys Arg Val Pro Gln Arg Leu Leu Glu Ile Ala Gly Val Ala Thr  
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 Phe Trp Ala Trp Tyr Pro Leu Leu Val Ala Ser Leu Pro Asn Trp Trp  
 305 310 315 320  
 Glu Arg Val Ala Phe Val Leu Phe Ser Phe Thr Ile Cys Gly Ile Gln  
 325 330 335  
 His Val Gln Phe Cys Leu Asn His Phe Ser Ser Asp Val Tyr Val Gly  
 340 345 350  
 Pro Pro Lys Gly Asn Asp Trp Phe Glu Lys Gln Thr Ala Gly Thr Leu  
 355 360 365  
 Asp Ile Leu Cys Ser Pro Trp Met Asp Trp Phe His Gly Gly Leu Gln  
 370 375 380  
 Phe Gln Ile Glu His His Leu Phe Pro Arg Leu Pro Arg Cys His Leu  
 385 390 395 400  
 Arg Lys Val Ala Pro Ala Val Arg Asp Leu Cys Lys Lys His Gly Leu  
 405 410 415  
 Thr Tyr Ser Ala Ala Thr Phe Trp Gly Ala Asn Val Leu Thr Trp Lys  
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<212> PRT
<213> Glycine max

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                20                25                30
Asn Leu Phe Asn Arg Lys Gly His Thr Thr Ser Ile Leu Leu Ser Leu
                35                40                45
Ile Leu Thr Leu Phe Pro Leu Ser Val Cys Gly Val Leu Phe Ser Asp
  50                55                60

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Ser Thr Phe Val His Val Leu Ser Ala Ala Leu Ile Gly Phe Leu Trp  
 65 70 75 80  
 Ile Gln Ser Gly Trp Ile Gly His Asp Ser Gly His Tyr Asn Val Met  
 85 90 95  
 Leu Ser Arg Arg Leu Asn Arg Ala Ile Gln Ile Leu Ser Gly Asn Ile  
 100 105 110  
 Leu Ala Gly Ile Ser Ile Gly Trp Trp Lys Trp Asn His Asn Ala His  
 115 120 125  
 His Ile Ala Cys Asn Ser Leu Asp Tyr Asp Pro Asp Leu Gln His Met  
 130 135 140  
 Pro Val Phe Ala Val Ser Ser Arg Phe Phe Asn Ser Ile Thr Ser His  
 145 150 155 160  
 Xaa Tyr Gly Arg Lys Xaa Glu Phe Asp Xaa Ile Ala Xaa Phe Leu Ile  
 165 170 175  
 Cys Tyr Gln His Phe Thr Phe Tyr Pro Val Met Cys Val Ala Arg Val  
 180 185 190  
 Asn Leu Tyr Leu Gln Thr Ile Leu Leu Leu Phe Ser Arg Xaa Lys Val  
 195 200 205  
 Gln Asp Arg Ala Leu Asn Ile Met Gly Ile Leu Val Phe Trp Thr Trp  
 210 215 220  
 Phe Leu Phe Leu Leu Ala Leu Leu Phe Val Pro Ile Gln His Ile Gln  
 225 230 235 240  
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<210> 7  
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 <212> DNA  
 <213> Glycine max

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 gaagaaccag ataccccatt attgttctta tctatctatc tgtctatatt ctatttatct 240  
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 agcaatggag gttggtgaga aggagaagaa gtacataacc tcagaggagc tgaagggtca 360  
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<210> 8
<211> 450
<212> PRT
<213> Glycine max

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<400> 8
Met Glu Val Val Glu Lys Glu Lys Lys Tyr Ile Thr Ser Glu Glu Leu
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Lys Gly His Asn Lys Glu Gly Asp Leu Trp Ile Ser Ile Gln Gly Lys
          20                25                30

Val Tyr Asn Val Ser Asp Trp Val Lys Glu His Pro Gly Gly Asp Val
          35                40                45

Pro Ile Ser Asn Leu Ala Gly Gln Asp Val Thr Asp Ala Phe Ile Ala
          50                55                60

Tyr His Pro Gly Thr Ala Trp Ser His Leu Glu Lys Phe Phe Thr Gly
          65                70                75                80

Tyr His Leu Ser Asp Phe Lys Val Ser Glu Val Ser Lys Asp Tyr Arg
          85                90                95

Lys Leu Ala Ser Glu Phe Ser Lys Leu Gly Leu Phe Asp Thr Lys Gly
          100                105                110

His Val Thr Ser Cys Thr Leu Ala Ser Val Ala Val Met Phe Leu Ile
          115                120                125

Val Leu Tyr Gly Val Leu Arg Cys Thr Ser Val Trp Ala His Leu Gly
          130                135                140

Ser Gly Met Leu Leu Gly Leu Leu Trp Met Gln Ser Ala Tyr Val Gly
          145                150                155                160

His Asp Ser Gly His Tyr Val Val Met Thr Thr Asn Gly Phe Asn Lys
          165                170                175

Val Ala Gln Ile Leu Ser Gly Asn Cys Leu Thr Gly Ile Ser Ile Ala
          180                185                190

Trp Trp Lys Trp Thr His Asn Ala His His Ile Ala Cys Asn Ser Leu
          195                200                205

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Asp His Asp Pro Asp Leu Gln His Met Pro Val Phe Ala Val Ser Ser  
 210 215 220  
 Arg Phe Phe Asn Ser Ile Thr Ser His Phe Tyr Gly Arg Lys Leu Glu  
 225 230 235 240  
 Phe Asp Phe Ile Ala Arg Phe Leu Ile Cys Tyr Gln His Phe Thr Phe  
 245 250 255  
 Tyr Pro Val Met Cys Val Ala Arg Val Asn Leu Tyr Leu Gln Thr Ile  
 260 265 270  
 Leu Leu Leu Phe Ser Arg Arg Lys Val Gln Asp Arg Ala Leu Asn Ile  
 275 280 285  
 Met Gly Ile Leu Val Phe Trp Thr Trp Phe Pro Leu Leu Val Ser Cys  
 290 295 300  
 Leu Pro Asn Trp Pro Glu Arg Val Met Phe Val Leu Ala Ser Phe Ala  
 305 310 315 320  
 Val Cys Ser Ile Gln His Ile Gln Phe Cys Leu Asn His Phe Ala Ala  
 325 330 335  
 Asn Val Tyr Val Gly Pro Pro Ser Gly Asn Asp Trp Phe Glu Lys Gln  
 340 345 350  
 Thr Ser Gly Thr Leu Asp Ile Ser Cys Ala Ser Ser Met Asp Trp Phe  
 355 360 365  
 Phe Gly Gly Leu Gln Phe Gln Leu Glu His His Leu Phe Pro Arg Leu  
 370 375 380  
 Pro Arg Cys Gln Leu Arg Lys Ile Ser Pro Leu Val Ser Asp Leu Cys  
 385 390 395 400  
 Lys Lys His Asn Leu Pro Tyr Arg Ser Leu Ser Phe Trp Glu Ala Asn  
 405 410 415  
 Gln Trp Thr Ile Arg Thr Leu Arg Thr Ala Ala Leu Gln Ala Arg Asp  
 420 425 430  
 Leu Thr Asn Pro Ala Pro Lys Asn Leu Leu Trp Glu Ala Val Asn Thr  
 435 440 445

His Gly  
450

<210> 9

<211> 1972

<212> DNA

<213> Triticum aestivum

<400> 9

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 ccgatggccc gcacgggctt cgcggacgca acggcgccg aagccgacgc aatgccggcc 180  
 gccagcaagg acgccgccga cgtccgcatg atctccacca aggagctgca ggcgcacgct 240  
 gccgcggacg acctctggat ctccatctcc ggggacgtct acgacgtcac gccgtggctg 300  
 cgccaccacc cgggocggcga ggtcccgtc atcaccctcg ccggccagga cgccaccgac 360  
 gccttcatgg cctaccaccc gccctccgtg cgcccgtcc tccgccgctt cttcgtcggc 420

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cacatggttcg cccggcggcct cattggcttc atctggatcc agtcgggctg gattggccat 660
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gatggtttgt agcgtgtata tcctgctgct atggcagctt gaactgcatt ttgggaacat 1920
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<210> 10
<211> 469
<212> PRT
<213> Triticum aestivum

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<400> 10
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Met Pro Ala Ala Ser Lys Asp Ala Ala Asp Val Arg Met Ile Ser Thr
          20                25                30

Lys Glu Leu Gln Ala His Ala Ala Ala Asp Asp Leu Trp Ile Ser Ile
          35                40                45

Ser Gly Asp Val Tyr Asp Val Thr Pro Trp Leu Arg His His Pro Gly
  50                55                60

Gly Glu Val Pro Leu Ile Thr Leu Ala Gly Gln Asp Ala Thr Asp Ala
  65                70                75                80

Phe Met Ala Tyr His Pro Pro Ser Val Arg Pro Leu Leu Arg Arg Phe
          85                90                95

Phe Val Gly Arg Leu Ser Asp Tyr Thr Val Pro Pro Ala Ser Ala Asp
          100                105                110

Phe Arg Arg Leu Leu Ala Gln Leu Ser Ser Ala Gly Leu Phe Glu Arg
          115                120                125

Val Gly His Thr Pro Lys Phe Leu Leu Val Ala Met Ser Val Leu Phe
          130                135                140

Cys Ile Ala Leu Tyr Cys Val Leu Ala Cys Ser Ser Thr Gly Ala His

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145					150					155					160
Met	Phe	Ala	Gly	Gly	Leu	Ile	Gly	Phe	Ile	Trp	Ile	Gln	Ser	Gly	Trp
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Ile	Gly	His	Asp	Ser	Gly	His	His	Gln	Ile	Thr	Arg	His	Pro	Ala	Leu
			180					185					190		
Asn	Arg	Leu	Leu	Gln	Val	Val	Ser	Gly	Asn	Cys	Leu	Thr	Gly	Leu	Gly
		195					200					205			
Ile	Ala	Trp	Trp	Lys	Phe	Asn	His	Asn	Thr	His	His	Ile	Ser	Cys	Asn
	210					215					220				
Ser	Leu	Asp	His	Asp	Pro	Asp	Leu	Gln	His	Leu	Pro	Leu	Phe	Ala	Val
225					230					235					240
Ser	Thr	Lys	Leu	Phe	Asn	Asn	Leu	Trp	Ser	Val	Cys	Tyr	Glu	Arg	Thr
				245					250					255	
Leu	Ala	Phe	Asp	Ala	Ile	Ser	Lys	Phe	Phe	Val	Ser	Tyr	Gln	His	Trp
			260					265					270		
Thr	Phe	Tyr	Pro	Val	Met	Gly	Phe	Ala	Arg	Ile	Asn	Leu	Leu	Val	Gln
		275					280					285			
Ser	Ile	Val	Phe	Leu	Ile	Thr	Gln	Lys	Lys	Val	Arg	Gln	Arg	Trp	Leu
	290					295					300				
Glu	Ile	Ala	Gly	Val	Ala	Ala	Phe	Trp	Val	Trp	Tyr	Pro	Leu	Leu	Val
305					310					315					320
Ser	Cys	Leu	Pro	Asn	Trp	Trp	Glu	Arg	Val	Ala	Phe	Val	Leu	Ala	Ser
				325					330					335	
Phe	Val	Ile	Thr	Gly	Ile	Gln	His	Val	Gln	Phe	Cys	Leu	Asn	His	Phe
			340					345					350		
Ser	Ser	Ala	Val	Tyr	Val	Gly	Pro	Pro	Lys	Gly	Asn	Asp	Trp	Phe	Glu
		355					360					365			
Arg	Gln	Thr	Ala	Gly	Thr	Leu	Asp	Ile	Lys	Cys	Ser	Pro	Trp	Met	Asp
	370					375					380				
Trp	Phe	His	Gly	Gly	Leu	Gln	Phe	Gln	Val	Glu	His	His	Leu	Phe	Pro
385					390					395					400
Arg	Leu	Pro	Arg	Cys	His	Tyr	Arg	Met	Val	Ala	Pro	Ile	Val	Arg	Asp
				405					410					415	
Leu	Cys	Lys	Lys	His	Gly	Leu	Ser	Tyr	Gly	Ala	Ala	Thr	Phe	Trp	Glu
			420					425					430		
Ala	Asn	Val	Met	Thr	Trp	Lys	Thr	Leu	Arg	Ala	Ala	Ala	Leu	Gln	Ala
		435					440					445			
Arg	Glu	Ala	Thr	Thr	Gly	Ala	Ala	Pro	Lys	Asn	Leu	Val	Trp	Glu	Ala
	450					455					460				
Leu	Asn	Thr	His	Gly											
465															

<210> 11  
 <211> 448  
 <212> PRT  
 <213> Borago officinalis

<400> 11  
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 1 5 10 15  
 His Asp Lys Pro Gly Asp Leu Trp Ile Ser Ile Gln Gly Lys Ala Tyr  
 20 25 30  
 Asp Val Ser Asp Trp Val Lys Asp His Pro Gly Gly Ser Phe Pro Leu  
 35 40 45  
 Lys Ser Leu Ala Gly Gln Glu Val Thr Asp Ala Phe Val Ala Phe His  
 50 55 60  
 Pro Ala Ser Thr Trp Lys Asn Leu Asp Lys Phe Phe Thr Gly Tyr Tyr  
 65 70 75 80  
 Leu Lys Asp Tyr Ser Val Ser Glu Val Ser Lys Asp Tyr Arg Lys Leu  
 85 90 95  
 Val Phe Glu Phe Ser Lys Met Gly Leu Tyr Asp Lys Lys Gly His Ile  
 100 105 110  
 Met Phe Ala Thr Leu Cys Phe Ile Ala Met Leu Phe Ala Met Ser Val  
 115 120 125  
 Tyr Gly Val Leu Phe Cys Glu Gly Val Leu Val His Leu Phe Ser Gly  
 130 135 140  
 Cys Leu Met Gly Phe Leu Trp Ile Gln Ser Gly Trp Ile Gly His Asp  
 145 150 155 160  
 Ala Gly His Tyr Met Val Val Ser Asp Ser Arg Leu Asn Lys Phe Met  
 165 170 175  
 Gly Ile Phe Ala Ala Asn Cys Leu Ser Gly Ile Ser Ile Gly Trp Trp  
 180 185 190  
 Lys Trp Asn His Asn Ala His His Ile Ala Cys Asn Ser Leu Glu Tyr  
 195 200 205  
 Asp Pro Asp Leu Gln Tyr Ile Pro Phe Leu Val Val Ser Ser Lys Phe  
 210 215 220  
 Phe Gly Ser Leu Thr Ser His Phe Tyr Glu Lys Arg Leu Thr Phe Asp  
 225 230 235 240  
 Ser Leu Ser Arg Phe Phe Val Ser Tyr Gln His Trp Thr Phe Tyr Pro  
 245 250 255  
 Ile Met Cys Ala Ala Arg Leu Asn Met Tyr Val Gln Ser Leu Ile Met  
 260 265 270  
 Leu Leu Thr Lys Arg Asn Val Ser Tyr Arg Ala His Glu Leu Leu Gly  
 275 280 285

Cys Leu Val Phe Ser Ile Trp Tyr Pro Leu Leu Val Ser Cys Leu Pro  
 290 295 300  
 Asn Trp Gly Glu Arg Ile Met Phe Val Ile Ala Ser Leu Ser Val Thr  
 305 310 315 320  
 Gly Met Gln Gln Val Gln Phe Ser Leu Asn His Phe Ser Ser Ser Val  
 325 330 335  
 Tyr Val Gly Lys Pro Lys Gly Asn Asn Trp Phe Glu Lys Gln Thr Asp  
 340 345 350  
 Gly Thr Leu Asp Ile Ser Cys Pro Pro Trp Met Asp Trp Phe His Gly  
 355 360 365  
 Gly Leu Gln Phe Gln Ile Glu His His Leu Phe Pro Lys Met Pro Arg  
 370 375 380  
 Cys Asn Leu Arg Lys Ile Ser Pro Tyr Val Ile Glu Leu Cys Lys Lys  
 385 390 395 400  
 His Asn Leu Pro Tyr Asn Tyr Ala Ser Phe Ser Lys Ala Asn Glu Met  
 405 410 415  
 Thr Leu Arg Thr Leu Arg Asn Thr Ala Leu Gln Ala Arg Asp Ile Thr  
 420 425 430  
 Lys Pro Leu Pro Lys Asn Leu Val Trp Glu Ala Leu His Thr His Gly  
 435 440 445

<210> 12  
 <211> 469  
 <212> PRT  
 <213> Triticum aestivum

<400> 12  
 Met Ala Arg Thr Gly Leu Ala Asp Ala Thr Ala Pro Glu Ala Asp Ala  
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 Met Pro Ala Ala Ser Lys Asp Ala Ala Asp Val Arg Met Ile Ser Thr  
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 Lys Glu Leu Gln Ala His Ala Ala Ala Asp Asp Leu Trp Ile Ser Ile  
 35 40 45  
 Ser Gly Asp Val Tyr Asp Val Thr Pro Trp Leu Arg His His Pro Gly  
 50 55 60  
 Gly Glu Val Pro Leu Ile Thr Leu Ala Gly Gln Asp Ala Thr Asp Ala  
 65 70 75 80  
 Phe Met Ala Tyr His Pro Pro Ser Val Arg Pro Leu Leu Arg Arg Phe  
 85 90 95  
 Phe Val Gly Arg Leu Thr Asp Tyr Thr Val Pro Pro Ala Ser Ala Asp  
 100 105 110  
 Phe Arg Arg Leu Leu Ala Gln Leu Ser Ser Ala Gly Leu Phe Glu Arg  
 115 120 125  
 Val Gly His Thr Pro Lys Phe Leu Leu Val Ala Met Ser Val Leu Phe

130						135											140
Cys 145	Ile	Ala	Leu	Tyr	Cys 150	Val	Leu	Ala	Cys	Ser 155	Ser	Thr	Gly	Ala	His 160		
Met	Phe	Ala	Gly	Gly 165	Leu	Ile	Gly	Phe	Ile 170	Trp	Ile	Gln	Ser	Gly 175	Trp		
Ile	Gly	His	Asp 180	Ser	Gly	His	His	Gln 185	Ile	Thr	Arg	His	Pro 190	Ala	Leu		
Asn	Arg	Leu	Leu	Gln	Val	Val	Ser 200	Gly	Asn	Cys	Leu	Thr 205	Gly	Leu	Gly		
Ile	Ala	Trp	Trp	Lys	Phe	Asn 215	His	Asn	Thr	His	His 220	Ile	Ser	Cys	Asn		
Ser 225	Leu	Asp	His	Asp	Pro 230	Asp	Leu	Gln	His	Leu 235	Pro	Leu	Phe	Ala	Val 240		
Ser	Thr	Lys	Leu	Phe 245	Asn	Asn	Leu	Trp	Ser 250	Val	Cys	Tyr	Glu	Arg 255	Thr		
Leu	Ala	Phe	Asp 260	Ala	Ile	Ser	Lys	Phe 265	Phe	Val	Ser	Tyr	Gln 270	His	Trp		
Thr	Phe	Tyr 275	Pro	Val	Met	Gly	Phe 280	Ala	Arg	Ile	Asn 285	Leu	Leu	Val	Gln		
Ser	Ile 290	Val	Phe	Leu	Ile	Thr 295	Gln	Lys	Lys	Val	Arg 300	Gln	Arg	Trp	Leu		
Glu 305	Ile	Ala	Gly	Val	Ala 310	Ala	Phe	Trp	Val	Trp 315	Tyr	Pro	Leu	Leu	Val 320		
Ser	Cys	Leu	Pro	Asn 325	Trp	Trp	Glu	Arg	Val 330	Ala	Phe	Val	Leu	Ala 335	Ser		
Phe	Val	Ile	Thr 340	Gly	Ile	Gln	His 345	Val	Gln	Phe	Cys	Leu	Asn 350	His	Phe		
Ser	Ser	Ala 355	Val	Tyr	Val	Gly	Pro 360	Pro	Lys	Gly	Asn	Asp 365	Trp	Phe	Glu		
Arg	Gln 370	Thr	Ala	Gly	Thr	Leu 375	Asp	Ile	Lys	Cys	Ser 380	Pro	Trp	Met	Asp		
Trp 385	Phe	His	Gly	Gly	Leu 390	Gln	Phe	Gln	Val	Glu 395	His	His	Leu	Phe	Pro 400		
Arg	Leu	Pro	Arg	Cys 405	His	Tyr	Arg	Met	Val 410	Ala	Pro	Ile	Val	Arg 415	Asp		
Leu	Cys	Lys	Lys 420	His	Gly	Leu	Ser	Tyr 425	Gly	Ala	Ala	Thr	Phe 430	Trp	Glu		
Ala	Asn	Val 435	Met	Thr	Trp	Lys	Thr 440	Leu	Arg	Ala	Ala	Ala 445	Leu	Gln	Ala		
Arg	Glu 450	Ala	Thr	Thr	Gly	Ala 455	Ala	Pro	Lys	Asn	Leu 460	Val	Trp	Glu	Ala		

Leu Asn Thr His Gly  
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<210> 13  
<211> 458  
<212> PRT  
<213> Helianthus annuus

<400> 13  
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Lys Tyr Ile Thr Ser Lys Glu Leu Lys Lys His Asn Asn Pro Asn Asp  
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Leu Trp Ile Ser Ile Leu Gly Lys Val Tyr Asn Val Thr Glu Trp Ala  
35 40 45  
Lys Glu His Pro Gly Gly Asp Ala Pro Leu Ile Asn Leu Ala Gly Gln  
50 55 60  
Asp Val Thr Asp Ala Phe Ile Ala Phe His Pro Gly Thr Ala Trp Lys  
65 70 75 80  
His Leu Asp Lys Leu Phe Thr Gly Tyr His Leu Lys Asp Tyr Gln Val  
85 90 95  
Ser Asp Ile Ser Arg Asp Tyr Arg Lys Leu Ala Ser Glu Phe Ala Lys  
100 105 110  
Ala Gly Met Phe Glu Lys Lys Gly His Gly Val Ile Tyr Ser Leu Cys  
115 120 125  
Phe Val Ser Leu Leu Leu Ser Ala Cys Val Tyr Gly Val Leu Tyr Ser  
130 135 140  
Gly Ser Phe Trp Ile His Met Leu Ser Gly Ala Ile Leu Gly Leu Ala  
145 150 155 160  
Trp Met Gln Ile Ala Tyr Leu Gly His Asp Ala Gly His Tyr Gln Met  
165 170 175  
Met Ala Thr Arg Gly Trp Asn Lys Phe Ala Gly Ile Phe Ile Gly Asn  
180 185 190  
Cys Ile Thr Gly Ile Ser Ile Ala Trp Trp Lys Trp Thr His Asn Ala  
195 200 205  
His His Ile Ala Cys Asn Ser Leu Asp Tyr Asp Pro Asp Leu Gln His  
210 215 220  
Leu Pro Met Leu Ala Val Ser Ser Lys Leu Phe Asn Ser Ile Thr Ser  
225 230 235 240  
Val Phe Tyr Gly Arg Gln Leu Thr Phe Asp Pro Leu Ala Arg Phe Phe  
245 250 255  
Val Ser Tyr Gln His Tyr Leu Tyr Tyr Pro Ile Met Cys Val Ala Arg  
260 265 270



Val Asn Leu Tyr Leu Gln Thr Ile Leu Leu Leu Ile Ser Lys Arg Lys  
                   275                                  280                                  285  
 Ile Pro Asp Arg Gly Leu Asn Ile Leu Gly Thr Leu Ile Phe Trp Thr  
                   290                                  295                                  300  
 Trp Phe Pro Leu Leu Val Ser Arg Leu Pro Asn Trp Pro Glu Arg Val  
                   305                                  310                                  315                                  320  
 Ala Phe Val Leu Val Ser Phe Cys Val Thr Gly Ile Gln His Ile Gln  
                                   325                                  330                                  335  
 Phe Thr Leu Asn His Phe Ser Gly Asp Val Tyr Val Gly Pro Pro Lys  
                                   340                                  345                                  350  
 Gly Asp Asn Trp Phe Glu Lys Gln Thr Arg Gly Thr Ile Asp Ile Ala  
                                   355                                  360                                  365  
 Cys Ser Ser Trp Met Asp Trp Phe Phe Gly Gly Leu Gln Phe Gln Leu  
                   370                                  375                                  380  
 Glu His His Leu Phe Pro Arg Leu Pro Arg Cys His Leu Arg Ser Ile  
                                   385                                  390                                  395                                  400  
 Ser Pro Ile Cys Arg Glu Leu Cys Lys Lys Tyr Asn Leu Pro Tyr Val  
                                   405                                  410                                  415  
 Ser Leu Ser Phe Tyr Asp Ala Asn Val Thr Thr Leu Lys Thr Leu Arg  
                                   420                                  425                                  430  
 Thr Ala Ala Leu Gln Ala Arg Asp Leu Thr Asn Pro Ala Pro Gln Asn  
                                   435                                  440                                  445  
 Leu Ala Trp Glu Ala Phe Asn Thr His Gly  
                   450                                  455

<210> 14  
 <211> 35  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Definition of Artificial Sequence: PCR primer for 5' of pk0011.d5

<400> 14  
 ttgcggccg caaatcaatg gaagaagcaa agaag 35

<210> 15  
 <211> 33  
 <212> DNA  
 <213> Artificial Sequence

<220>  
 <223> Definition of Sequence: antisense PCR primer for 3' of pk0011.d5

<400> 15  
 ttgcggccg ccaggattca cccgaaagtg ttc 33

<210> 16  
 <211> 823  
 <212> DNA

<213> Triticum aestivum

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<222> (807)  
<223> n = A, C, G, or T

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cttcctcctg agtcctgacc acccctcctc gcgctccagc taaatccacg ccaccgatgg 120  
cccgcacggg cttcgoggac gcaacggcgc cggaagccga cgcaatgccg gccgccagca 180  
aggacgccgc cgacgtccgc atgatctcca ccaaggagct gcaggcgcac gccgccgcyg 240  
acgacctctg gatctccatc tccggggagc tctacgacgt cacgccctgg ctgcgccacc 300  
accggggcgg cgaggtoocg ctcatcacc tgcgcggcca ggacgccacc gacgccttca 360  
tggcctacca cccgccctcc gtgcgcccgc tctctcgccg cttcttctgc ggccgcctca 420  
ccgactacac tgtccccccc gcctccgccc acttccgccc cctcctcgcg cagctctcct 480  
ccgcgggcct cttcgagcgc gtcggcacac ccccaagttc ctgctcgtcg caaagtcngt 540  
gctcttctgc atcggcctct actgctcctc gcctgctcaa caccggggcc acatgttcgc 600  
cgggggctca ttggettata tggtcagtcg ggctggattg gcatactccg gcacacaaat 660  
cacaggcacc tgcctcaacg ctctgnagtg gctcgggaat gctnacggct cggatcncctg 720  
gggagtnanc acacaanaca nattctgaan ngtcacatac ctgactcana ttccgtntcg 780  
ggtcacaagt ctaaaacttg catcgtnaag acttggttag cat 823

<210> 17  
<211> 114  
<212> PRT  
<213> Triticum aestivum

<400> 17  
Met Pro Ala Ala Ser Lys Asp Ala Ala Asp Val Arg Met Ile Ser Thr  
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Lys Glu Leu Gln Ala His Ala Ala Ala Asp Asp Leu Trp Ile Ser Ile  
20 25 30  
Ser Gly Asp Val Tyr Asp Val Thr Pro Trp Leu Arg His His Pro Gly  
35 40 45  
Gly Glu Val Pro Leu Ile Thr Leu Ala Gly Gln Asp Ala Thr Asp Ala  
50 55 60  
Phe Met Ala Tyr His Pro Pro Ser Val Arg Pro Leu Leu Arg Arg Phe  
65 70 75 80  
Phe Val Gly Arg Leu Thr Asp Tyr Thr Val Pro Pro Ala Ser Ala Asp  
85 90 95  
Phe Arg Arg Leu Leu Ala Gln Leu Ser Ser Ala Gly Leu Phe Glu Arg  
100 105 110  
Val Gly